OEP Metrics Plan

Industry Coordination Draft

September 2002

This draft plan is provided to the aviation community for comment. Comments received by October 16, 2002 will be considered for incorporation into the final plan.
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Version 1.2 September 30, 2002

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Section 1: Introduction

This document presents the performance metrics and measurement methodologies that will be used to evaluate the effectiveness of capacity and efficiency improvements implemented under the Operational Evolution Plan (OEP). The OEP is the aviation industry's implementation plan for the evolution of capacity and efficiency improvements needed in the National Airspace System (NAS) to meet future air traffic demand over the next decade. Performance metrics are designed to provide important data on how actual operational improvements compare to the OEP objective of ensuring that NAS capacity expands to efficiently meet increased demand levels.

1.1 Background

The OEP is the Federal Aviation Administration's (FAA) commitment to meet the air transportation needs of the United States in the next ten years by increasing capacity and decreasing delays, while continuing to carry out safe and secure operations. The OEP is a collaborative effort led by the FAA with input from members of the entire aviation industry. This metrics plan will be released with version 5.0 of the OEP, in December 2002.

The OEP is presented in four quadrants, each representing a core area of NAS performance. These quadrants are:

Arrival/Departure Rates

En Route Congestion

Airport Weather Conditions

En Route Severe Weather

Within each quadrant there are multiple solution sets that detail the specific initiatives to be implemented. A single Point of Delivery (POD) has been assigned to manage each solution set and to be held accountable for delivering the new service or capability, as well as the expected operational improvement. The OEP contains a "Smart Sheet" for each of these solution sets that detail the operational change, key decisions, risks, and milestones and the expected benefits, performance improvements, and metrics measures that will be afforded by the change. Each Smart Sheet also identifies the organization that is the POD for that set of solutions.

1.2 Purpose and Scope

The findings derived through execution of this plan will play an important part in the performance management of the OEP. The OEP Metrics will provide important feedback on how well improvements and operations compare to OEP expectations. The results will also be useful in calibrating models that estimate the impact of planned capacity and efficiency improvements on NAS operations given future demand levels. New model estimates of the future may impact the prioritization of initiatives and alter OEP objectives.

OEP performance metrics are strategic in nature, and aim to measure changes in NAS capacity and efficiency year-over-year. The purpose is to define the strategic performance measurement (metrics and methods) for evaluation of the combined effect of the OEP initiatives.

The categorization of metrics in this OEP Metrics Plan follows the FAA's established performance measurement categories. The FAA has used the following customer-based outcome categories to express operational performance: accessibility (capacity and throughput), efficiency, predictability, flexibility, and safety. This OEP Metrics Plan will focus on the operational impacts of the OEP initiatives on capacity, throughput, and efficiency

This document outlines current plans for evaluation of the OEP initiatives. It will evolve along with the OEP. As improved methods and data sources are created, they will also be employed in execution of this plan. This coordination draft is provided to the aviation community for review and comment.

1.3 Relationship to Other FAA Metrics

The majority of performance metrics generated and analyzed by the FAA are more tactical than strategic. Some are very tactical and were developed to determine how the NAS operated the previous day and the changes that could be made to improve service today. Others are less tactical, but used to make near term decisions, such as the operational evaluation of prototypes, initial production units, or new procedures. The evaluations done on these changes help to determine whether the expected operational impact has been realized as well as the location and quantity of sites these changes are likely to benefit.

Although these types of analyses are very useful, they tend to be conducted for a relatively short duration after implementation. Findings from the more tactical studies will usually be available sooner than the overall OEP strategic results, and can be used as a preliminary indication of whether a change will meet expectations. The PODs will conduct the detailed analyzes for their initiatives. The individual "Smart Sheets" contain descriptions of the benefits, performance, and metrics for the corresponding solution set. While this plan does not cover the methods for collecting these measures, the plan describes the ties to the tactical measures used to monitor individual initiatives. A more detailed explanation and example of POD analyses is contained in Appendix B of this plan.

As the FAA moves towards a performance based organization (PBO), a number of metrics will be collected and used by the FAA's Air Traffic Organization (ATO) including measures for safety, fiscal management, operations and aviation industry trends. It is the later two of these areas that relate to the combined effect of the OEP changes. The ATO operations and industry trend measures are integrated in the OEP metrics as top-level performance indicators.

Unique OEP measures will help to identify where improvements are needed and to measure the success of these improvements in terms of increased capacity and enhanced system efficiency. OEP analyses will synchronize the results from the lower level, program specific tactical measures, higher-level system-wide measures, and ATO metrics into a consistent summary of the effects of the OEP.

1.4 Reporting

Both formal and informal reporting mechanisms will be used to share the results of operational evaluations with the aviation community.

The findings and results gained through execution of this plan will be reported to the FAA's OEP executive level management and the aviation community as a semi-annual report on the OEP. The first planned publication of an OEP Metrics Report is December 2002. The dates of subsequent publications are yet to be determined, but it is anticipated that a report will be issued every June and December. The OEP Metrics Reports will be synchronized with the annual publication of the Operational Evolution Plan so that planning changes are reflected in the performance measurement process. The OEP Metrics Report will contain details of collective OEP operational performance impacts and benefits for the NAS, as well as any significant results found at the local and regional levels. This report draws the distinction between initial and future OEP metrics. The initial metrics period consists of the first two reporting cycles in December 2002 and June 2003.

OEP findings will initially be coordinated with the PODs at informal meetings. The PODs will use this forum to bring forward any issues. These issues will be worked prior to the metrics being briefed to the OEP executive level managers and the aviation community. Upon completion of an initiative, the PODs will brief their metric results at the OEP Executive Meeting. Current methods and schedules for release of POD metric reports will remain unchanged.

1.5 Document Organization

An explanation of the principle OEP performance measurements and evaluation activities is provided in Section 2.0 – Evaluation Overview. Section 3.0 presents the Methods and Data Sources that will initially guide the evaluation. Section 4.0 describes the primary OEP macro level measures. Primary Airport and En Route Measures are explained in sections 5.0 and 6.0, respectively. Appendix A presents the candidate airport and metro-pairs to be used in the analyses. Appendix B provides an overview and example of the types of metrics evaluated by the PODs.

Section 2: Evaluation Overview

The primary objective of the OEP is to ensure that NAS capacity is increased to keep pace with future demand. Modeling work has been done to estimate the demand and capacity relationship with and without the OEP. Results from this modeling work have been used to provide a benchmark or goals against which the OEP can be measured. The major focus of the OEP metrics work will be to measure performance against these goals. As the OEP is a capacity enhancement plan, the metrics contained in this plan relate to accessibility (capacity and throughput) and efficiency.

2.1 OEP Goals

The OEP Metrics Plan uses *effective capacity* to capture the synergy between capacity and demand changes. Effective capacity measures the theoretical volume of traffic that can be handled at a fixed level of delay. The analytic work used to estimate the effective capacity contributions of the OEP initiatives used the results of modeling work that estimated the capacity improvements needed to meet future demand levels. The models used were based on assumed airport arrival capacity with and without the OEP initiatives.

The model used these capacity levels to estimate the average minutes late per flight. The assumed airport capacity levels can also be viewed as surrogate goals for Arrival/Departure (AD) and Airport Weather Conditions (AW) solution sets. Additional assumptions regarding airspace access and travel times were used for the establishment of goals for En Route Congestion (ER) and En Route Severe Weather (EW) solutions sets.

Figure 1, known as the OEP Mountain Chart, reflects the estimated annual growth in effective capacity enabled by implementation of the OEP by OEP quadrant. Some AD benefits may not be realized without corresponding ER enhancements being implemented. An example is the implementation of a new runway at Detroit Metropolitan Wayne County (DTW). Without the necessary airspace enhancements and redesign, the utilization of the new runway would be minimal. The synergy between such AD and ER initiatives is reflected in the chart as the shading indicates.

The quality of the model and the assumptions regarding the impact of OEP initiatives will be refined with subsequent versions of the OEP. As the OEP initiatives are implemented, actual operational changes will be used to determine whether the expected effective capacity increases were achieved. Two ATO metrics can be used for this purpose: average daily flights and average minutes late per flight.

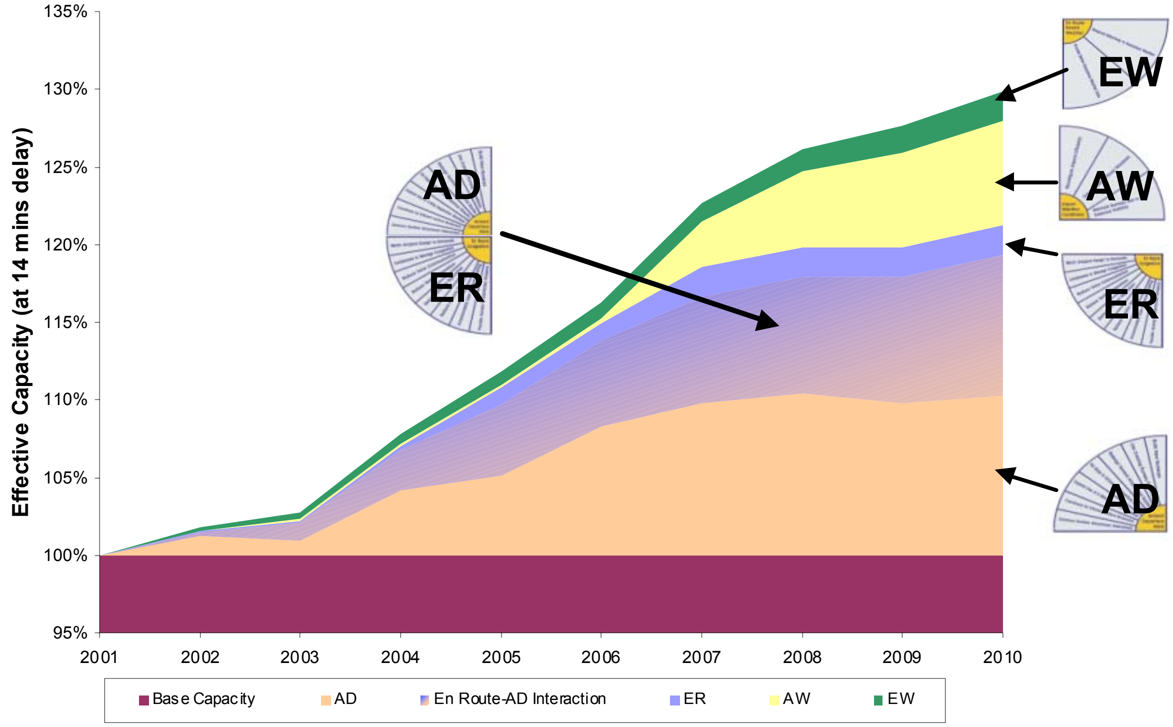

Figure 1. Effective Capacity by OEP Quadrant

The OEP Mountain Chart represents the relationship between traffic volume demand and average aircraft delay. A notional representation of this relationship with and without the OEP is shown in Figure 2. The delay-volume projection curves represent the expected trade-off between traffic volume and the average delay per flight with no change in NAS capacity. With an increase in capacity afforded by implementation of OEP initiatives, the delay-volume projection curve shifts to the right. In the example below, the implementation of the OEP enables an increased traffic level to be met with a decrease in the average delay per flight. The effective capacity improvement is measured by the amount of additional traffic that can be handled at the original level of delay.

In the future, comparing the *actual* traffic volume to the corresponding OEP effective capacity *estimate*, the expected average delay per flight can be estimated. Conversely, given the *measured* delay per flight, the expected traffic volume can be estimated. By estimating the volume and the average delay, both results can be compared to the measured (actual) values. The result of this comparison will provide two performance indicators: the excess or shortfall achieved in the average minutes late per flight, and the number of flights under or over the expected demand at a fixed level of delay.

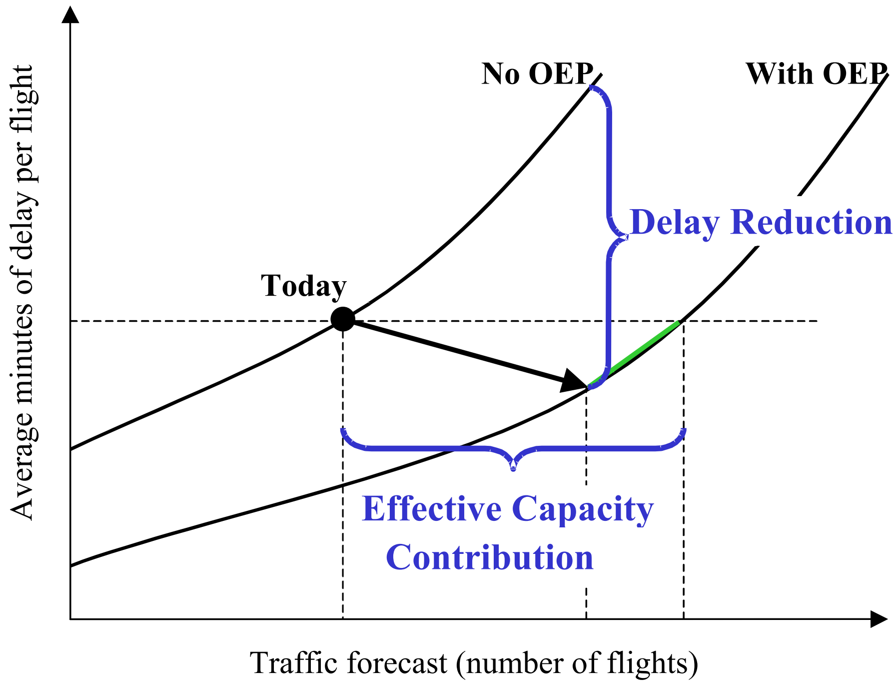

Figure 2. Effective Capacity: Delay-Volume Relationship

2.2 Evaluating OEP Outcomes

The major OEP outcomes are accessibility (capacity and throughput) and efficiency. A single OEP solution can impact both accessibility and efficiency. Similarly, the same metric can yield results that pertain to changes in both accessibility and efficiency. For example, a decrease in flight time can signify both improved accessibility and efficiency. As the distinction between the two outcome categories is often difficult, the OEP metrics generally do not segregate one from the other. However, descriptions of these two key OEP outcome categories are provided below to aid in putting the metrics detailed in the remainder of this plan into context.

2.2.1 Accessibility: Capacity and Throughput

Access is focused on the users' ability to enter the Air Traffic Control (ATC) system and obtain services on demand. For OEP purposes, user accessibility is measured in the capacity and throughput the FAA can deliver during periods of peak demand. Capacity refers to the potential service rate for a given period of time, such as the number of accepted arrivals per hour. Throughput relates to the number of operations actually serviced in a given period of time, such as the number of aircraft that actually landed. Capacity and throughput performance metrics are key performance indicators presented in this plan.

When demand is greater than throughput, delays result. In this case, if capacity is greater than throughput, increased throughput can decrease delays without a capacity increase. When throughput is equal to capacity and demand is greater, a capacity improvement would be needed to decrease delays. As demand continues to increase over time, improved access to airspace and runways will be needed if delays are to remain constant or decrease. Evaluation of accessibility depends on the analysis of the relationship between capacity, throughput and delay.

2.2.2 Efficiency

Efficiency improvements are achieved when the system increasingly accommodates the granting of user preferred routes and altitudes. Measures of system efficiency focus on flight time and distance, with increased efficiency achieved through reductions in these measures. The effect of winds on flight times and the user's preferred route, make precise efficiency results difficult to discern. The direct benefit to airspace users is often measured through reduced flight time. Analyses of large data sets are also performed using a measure of flight distance, with changes in distance converted back to flight time using nominal aircraft speeds. Distance is most effective as a measure over shorter routes or flight segments when wind optimal routes are not an objective. Flight segments can be defined as the length of an entire flight path or some portion of that path. Analysis of flight segments allows for measurement of specific phases of flight. Both time and distance measures are included in this metrics plan. New techniques are being developed to normalize these efficiency results for the effects of winds, and these techniques will be explored in execution of this plan.

Fuel burn is another meaningful measure of efficiency. However, actual fuel burn performance data is not available to the FAA. Therefore, any measure of fuel burn savings must be based on the application of generic aircraft performance data or the use of fuel burn models. One approach to this problem is to use aggregate level data of fuel burn at specific altitudes for specific models of aircraft. As the distance savings are quantified using actual flight track data, these fuel burn rates can be applied to yield a dollar benefit for the airspace user. This method can be used to provide a rough-order figure as to the potential savings in fuel for a particular NAS enhancement. Any application of this approach will be conducted in collaboration with users to determine the applicability of the specific approach with respect to the OEP initiatives.

2.3 Metrics By Areas of NAS Performance

OEP metrics are presented for core areas of NAS performance, in line with the structure of the OEP. One of the objectives of the OEP Metrics Plan is to include measures that will provide performance results for each of the OEP quadrants and for the OEP as a whole. The basic metrics for both AD and AW or ER and EW are the same. The differences relate to the weather conditions under which the metrics are measured. As proven methods do not exist for separation of weather impacts from NAS operational data, this initial metrics plan will combine the evaluation of AD and AW and ER and EW impacts. During the initial execution of this plan, efforts will be made to develop meaningful ways to segregate NAS operations data by weather condition. Once this is achieved, the ultimate objective of having metrics categories for each quadrant will be possible. In the meantime, this initial metrics plan will include evaluation metrics for three areas of NAS performance: Macro NAS Level measures, Airport/Terminal Environment measures, and En Route Environment measures. The Macro Level metrics are designed to measure the effects of the OEP as a whole on the NAS. The Airport/Terminal Environment measures are geared towards capturing the impact of both the AD and AW OEP quadrants, while the En Route Environment metrics relate to the ER and EW quadrants.

Within each of the areas of NAS performance, there are Primary and Secondary metrics. The Primary metric is the main indicator of OEP impact on that NAS performance area. The Secondary metrics play two roles. The first role is to provide additional performance area level metrics to confirm the results of the primary metrics. The second role is to provide additional information that is needed to put the metrics into context, including weather information (e.g., prevailing winds, ceiling, and visibility) and traffic demand changes. These will help to either prepare the primary metrics or analyze the meaning of its result.

Many of the secondary metrics relate to more than one NAS performance area, and so are included under multiple areas. These metrics tend to relate to the location or domain where a delay is taken. The challenge is to develop ways to derive meaningful results on the cause of the delay. The initial execution of this plan will provide more information into the data available to segregate delays by cause.

Section 3: Methods and Data Sources

This section describes the general methodology and data sources that will be used to measure the capacity and efficiency impacts of the OEP initiatives. The initial focus will be to utilize readily available data (e.g., Aviation System Performance Measures (ASPM)) and metrics to achieve near-term analytic results, while simultaneously refining the plan to include more detailed and complex approaches, which will provide results in the longer term. Initially, this plan will concentrate on analysis of major areas of congestion in the NAS. The limited scope of the initial plan will enable the various metrics included in this report to be investigated for applicability and usefulness, with a manageable and representative data set. The results of these initial analyses will be used to identify those metrics, which yield meaningful information on cause and effect, and to refine (e.g., alter the metric) and expand (e.g., include more locations and measures) the focus.

3.1 Evaluation Baseline

Operational data from fiscal year (FY) 2000 will be used as the initial baseline for comparing capacity and efficiency effects due to OEP initiatives. This timeframe was chosen, in part, because the implementation of the OEP began in 2000, and correspondingly, this year formed the basis for the original modeling work. The operational data in FY 2001 and early FY 2002 might be anomalous and not serve as useful baseline years, due to the events of September 11, 2001 and the subsequent impact on the aviation industry. Nearly every year has some incidence of abnormal behavior, which leads to delays greater than the norm in a particular area of the country. Slot control restrictions were removed at LaGuardia Airport during FY 2000 and this may have led to higher than normal delays. Where data and resources permit, additional years prior to FY 2000 will be analyzed to validate the baseline data and to help with development of cause and effect relationships.

3.2 Congested Areas of Focus

There are hundreds of airports in the United States and thousands of combinations of airport pairs. The sheer volume of sites and site combinations makes analysis of the entire NAS a monumental task. Initially, the execution of this plan calls for analysis of selected airports, market pairs, and areas of airspace, based on those locations where current congestion exists or future congestion is expected. The initial dataset will provide a manageable framework for analysis and discovery. It is expected that much will be learned from the initial analysis, and these findings will aid in the eventual creation of automated data retrieval and analysis tools.

3.2.1 Airport/Terminal Environment

The initial focus of this OEP Metrics Plan will be on the top thirty-five (35) airports (hereafter called the benchmark airports). The next release of the Airport Capacity Benchmark Report (spring 2003) will be based on these thirty-five (35) airports.

This list is not intended to be exclusive, but rather inclusive: as additional airports may be studied if warranted. As measurement methods are developed and streamlined, it may be determined that additional airports need to be added to this list. The impact of multiple airports within the same metropolitan area will also be evaluated as data permits. The following benchmark airports will be the initial focus:

Atlanta (ATL)	Miami (MIA)
Baltimore/Washington (BWI)	Minneapolis St. Paul (MSP)
Boston Logan (BOS)	Memphis (MEM)
Charlotte (CLT)	Newark (EWR)
Chicago Midway (MDW)	Orlando (MCO)
Chicago O'Hare (ORD)	Phoenix (PHX)
Cincinnati/Covington (CVG)	Philadelphia (PHL)
Cleveland (CLE)	Pittsburgh (PIT)
Dallas/Ft. Worth (DFW)	Portland (PDX)
Denver (DEN)	Salt Lake City (SLC)
Detroit Wayne County (DTW)	San Diego (SAN)
Ft. Lauderdale (FLL)	San Francisco (SFO)
Honolulu (HNL)	Seattle (SEA)
Houston (IAH)	St. Louis (STL)
John F. Kennedy (JFK)	Tampa (TPA)
LaGuardia (LGA)	Washington Dulles (IAD)
Las Vegas (LAS)	Washington Reagan National (DCA)
Los Angeles (LAX)	

3.2.2 En Route Environment

Most of the data sources used to analyze NAS performance are collected and stored on a flight basis. The ultimate OEP goal for measuring en route capacity and efficiency is to analyze the impact of all flights traversing en route airspace. However, measurement of all flights in the NAS on a daily basis is a monumental task. Therefore, in order to achieve near-term results through manual manipulation of available data sources, a number of routes were chosen to represent en route system performance. In the longer term, the aim is to develop automated statistical tools, which will facilitate the analysis of all flights in the en route environment. In the interim, specific representative routes were chosen based on delays, operations, and market factors.

Roughly the same en route airspace is used for flights to and from the same geographic area. For this reason, the OEP Metrics Plan calls for evaluation of en route airspace based on flights from a metropolitan area as a whole (i.e., both primary and secondary area airports). For example, flights departing from and arriving into the San Francisco area will include flights from San Francisco International (SFO), Metropolitan Oakland International (OAK), and San Jose International (SJC). Figure 3 is a graphical representation of the recommended metro-pairs. The long and short haul routes contained in the recommended list are also identified pictorially. A listing of each metro-pair along with the specific airport pairs contained within it is included in Appendix A.

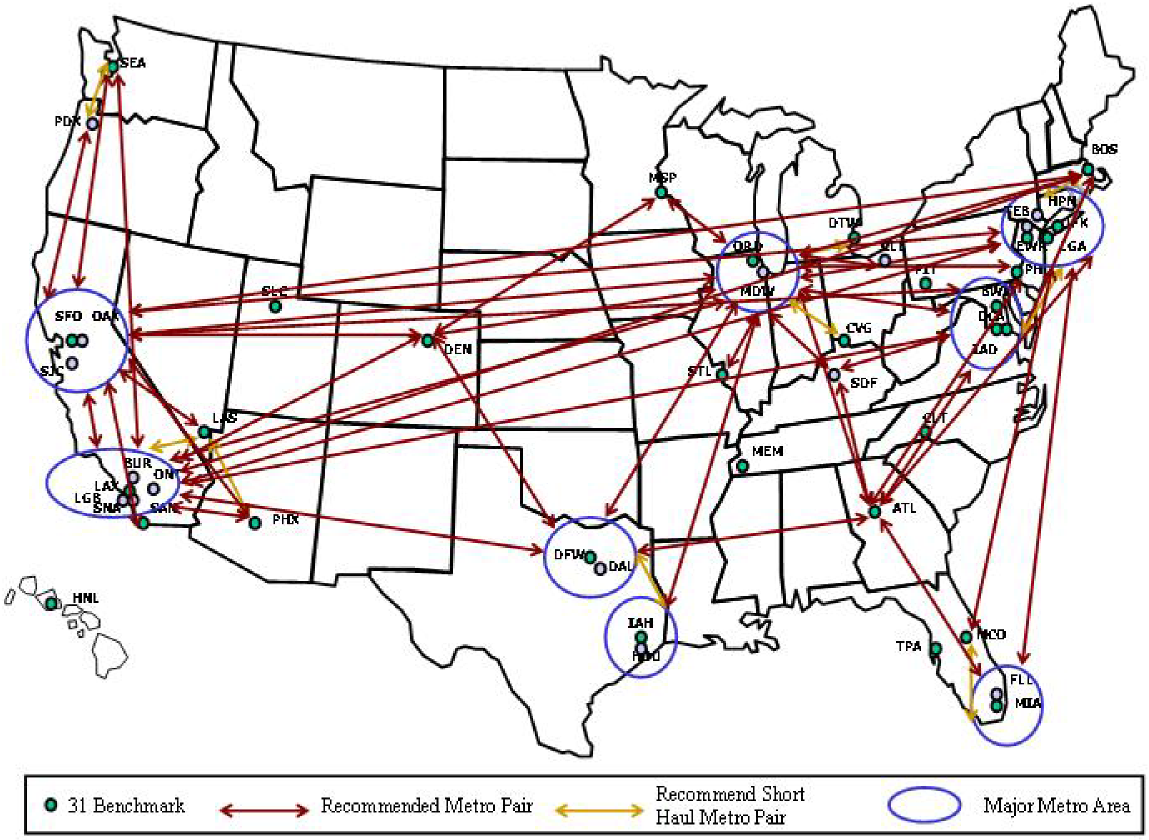

Figure 3. Candidate Metro-pairs

The metro-pairs were chosen based on analysis of flight count data, delay data, and other market factors. Route frequency was analyzed from both a city-pair and metropolitan pair perspective. Archived data from the Enhanced Traffic Management System (ETMS) for all of August 2001 was parsed to derive the total number of flights between all major hub airports and secondary airports near major hub airports in the Continental United States (CONUS). The result was a large matrix of all possible combinations. This matrix was analyzed to determine the most frequently flown routes on both a city-pairs and metropolitan pair basis. The FAA's Office of System Capacity performed a similar exercise with March 2001 ETMS data. As part of the En Route Benchmarking effort, they analyzed all flights between selected city-pairs more than 500 miles apart. Results from this effort were also used in the OEP metro-pair selection process. Operations Network (OPSNET) data from 2000-2001 was used to determine the airports with the largest number of arrival, departure, and traffic management system (TMS) delays, as well as delays due to center volume.

The results of these analyses were used to develop the recommended metro-pair list. Any route less than 100 miles was deemed to be more related to airport and terminal area demand and congestion, and therefore was discarded. The recommended list contains 52 metropolitan pairs that comprise of 261 airport pair combinations. The airports and corresponding Terminal Radar Approach Control (TRACONs) on the list, as well as all the CONUS Air Route Traffic Control Centers (ARTCC) experienced 94% of the total number of OPSNET reported delays, 93% of total arrival, 95% of total departure, 82% of total en route, and 94% of total TMS delays recorded in FY2000. They also accounted for 88% of the total FY2000 delays caused by center volume.

3.3 Levels of Measurement

OEP metrics will be evaluated at three levels of detail: macro, meso, and micro. Many measures will be examined from all three levels, starting at the macro level, and drilled-down to the micro level. Other metrics will only be pertinent at one level and so will not be examined in more or less detail.

Macro-level measures represent the highest level of performance evaluation – NAS-wide performance indicators such as system capacity and efficiency. The metrics that are utilized to convey the FAA's operational performance as a result of the PBO initiative are a perfect example of macro level metrics. These metrics are evaluated and reported so that the direct FAA customer has insight into how well the NAS is performing. This document details the plan to develop indices of throughput and efficiency focused on measuring the influence of the OEP initiatives.

Meso level metrics are tied to specific regions or areas of interest. Geographical regions of interest will be decided upon through collaboration with the aviation community. For example, meso level metrics would be used to measure the operational impact of the OEP initiatives on air traffic traversing the Great Lakes Corridor. Several regions have already been discussed and will be measured: New York region, Great Lakes Corridor, and specific Airspace Initiatives. It is anticipated that meso level measures will aid in communicating operational improvements to stakeholders who have specific interests in particular market areas.

Micro level metrics measure operational impacts in a specific location or area. A micro level performance metric measures the local operational benefit realized from the implementation of a new capability or procedure. Although this plan calls for the measurement of micro level measures, it is the PODs' responsibility to conduct detailed operational evaluations of the impact of new initiatives at specific implementation sites.

An evaluation of the new runway at DTW provides a good example of how these levels of measurement will be applied. The implementation of the new runway itself can be measured using several micro level metrics, including arrival and departure rates. The evaluation would then analyze whether or not the new runway is being used to increase the effective capacity of the airport at the micro level, had an impact on a regional area at the meso level, and finally on NAS performance overall at the macro level.

3.4 Analysis of Weather Effects

As mentioned in the previous section, a challenge in execution of this plan will be to develop ways to separate "bad" weather from "good." As the metrics vary across flight domains, so too does weather as an influencing factor. "Bad" weather is defined as any weather event that leads to a decrease in NAS capacity. The location and timing of a weather event strongly influences the effects it has on NAS capacity. Weather conditions at the airport surface are recorded for all the major airports and can be analyzed. However, airport throughput may be influenced by convective weather in the terminal and en route environments. At the macro level and in the en route environment, the challenge is to measure performance against the degree of weather impact (timing and location) from one day, week, or year to the next. A great deal of research has been conducted on ways to identify, analyze, and compare weather events. As of yet, a statistically significant method has not been identified.

The initial focus of this plan will vary by domain. In the en route environment, the first step will attempt to separate out the "good" weather days. In the airport environment, existing airport surface data will be used. It is expected that as the execution of this plan proceeds methods to segregate and control for the effects of weather will improve iteratively. Efforts to develop a statistically significant method of comparing weather events will continue.

3.5 Data Sources

Initial OEP analysis efforts will concentrate on using data sources that exist or can be created in the near term. As existing data sources were created for purposes other than execution of this plan, they may not contain all the data variables needed for the ideal investigation of OEP capacity and efficiency gains. Some of the OEP metrics are included in this plan because they are contained in these existing data sources and can be readily analyzed. Results gained from initial analyses will highlight any potential shortfalls that these data sources may present. As the execution of this plan proceeds, it is likely additional types of needed data and information will be identified and collected to improve the quality and accuracy of OEP performance metrics.

A large portion of the initial metrics will rely on data contained in the FAA's ASPM database. The ASPM database provides analysts with next day data pertaining to flight performance (actual and scheduled) from push-back at the gate for a departure to gate arrival at the destination airport, as well as airport operating conditions such as runways configuration, ceiling, visibility, wind speed and wind direction. The ASPM database currently includes all but one (HNL) of the 35-benchmark airports, under the initial evaluation plans. The initial analysis will use the ASPM data to analyze the 34 Benchmark airports, as well as 49 of the 52 representative metro-pairs (170 of the 261 airport pairing within the metro-pair list) contained in the ASPM database.

For airport measurement, the main indicators evaluated will be capacity, demand, and throughput, as described in Section 5 of this document. Additional measures contained in

ASPM, such as runway configuration, ceiling, visibility, wind speed, and wind direction, will be analyzed in order to put main indicators in context. Results from the initial analysis will be evaluated and any additional factors, deemed needed to derive more meaningful performance results, will be identified and appropriate data sources will be researched and included in future evaluations.

In addition to ASPM, data from the Enhanced Traffic Management System (ETMS) will also be used in the initial evaluation. ETMS flight track data is being collected to analyze in flight performance. As this analysis relates to the en route environment, details of the effort are contained in Section 6 of this document. Initially, the data is being collected for certain key city-pairs at standard intervals of time. If the initial analysis of this data shows promise, then the database will continue to be populated and automated.

Other databases and sources will be used for additional metrics, although many will not be used for the initial evaluation. Delay data will be calculated from the data sources described above and will include all increments of time. The FAA's OPSNET database will also be used to capture system delays by cause, as well as traffic count information. The delays contained in the OPSNET database are delays greater than 15 minutes in duration. Data on Revenue Passenger Mile (RPM) and Available Seat Mile (ASM) will be based on information collected and maintained by the Department of Transportation (DOT) Bureau of Transportation Statistics. On-time performance data is also available from the DOT. Information on weather will come from such sources as the National Climatic Data Center, National Oceanic and Atmospheric Administration, and the National Lightening Detection Network.

3.6 Probability and Statistics

Many of the metrics will focus on total and average values. Data will also be analyzed using a variety of other techniques. One of the techniques will be to develop the probability distributions for each of the key variables. Much of the base data that will be analyzed is maintained on an individual flight basis, and therefore the data sets are large. The majority of data contained in these databases is accurate, but there are likely to be some data errors. By analyzing the probability distribution, anomalous data will become apparent and true minimum flight times can be approximated as a given percentile. The minimal flight times are likely to provide a good baseline for optimal NAS performance. The distributions will also provide a measure of variation in the system as experienced by the user. The variation in the system will be an important measure of system predictability.

The use of peak traffic counts is an important indicator of throughput. The peak count for a given resource is the maximum number of aircraft serviced during a given time period. Analysis results will help to determine whether a single peak period or the average of multiple peak periods over a given day yields the more accurate representation of throughput.

The strategic focus of the OEP metrics leads to the measurement of change over a longer period of time. Changes will typically be measured year-over-year. However, metrics will also be compared on a seasonal basis against the prior year's performance. This will enable seasons in which weather tends to have less of an influence on air traffic to be compared one against the other. It will also enable comparison of data between times when prevailing winds tend to be similar.

3.7 Future Plans

This OEP Metrics Plan presents the current approach (e.g., metrics, methods and data sources) that will be used to measure the benefits of OEP initiatives. As this plan is coordinated with the aviation community, additional inputs may influence the direction of this plan and/or define additional analyses.

Under the auspices of this plan, alternative approaches are being pursued to add breadth and depth to OEP Metrics. Some of these approaches are being explored in academia, and as they are still in the concept development phase, are not described in this plan. Other approaches are still being considered including development of an information delivery system that will convert raw ETMS data into meaningful information. This system would utilize commercial relational databases to store ETMS NAS flight information for all flights, and use a powerful statistical tool to conduct analyzes. Such a system would enable analysis of all flights for which a flight plan is filed as well as estimation of en route delays on a sector-by-sector basis.

Section 4: OEP Macro Level Metrics

There are certain metrics that will be used primarily to evaluate the performance of the NAS as a whole. These metrics either cover multiple NAS domains and therefore, multiple OEP quadrants, and/or provide more meaning at the macro level, than they do at the micro or meso level. These metrics include the ATO metrics that are integrated in the OEP metrics plan as top-level performance indicators. Top-level performance indicators are diagnostic in nature, and provide the aviation community with a state of the NAS. These metrics will be used to investigate whether total system performance has improved. Metrics expected to be included in the initial analysis are presented in italics and bold black print. Those measures that will be added in the future are presented in italics and bold gray print.

4.1 Primary Macro Level OEP Metric – Effective Capacity

The ***average minutes late per flight*** and ***average number of daily flights*** will be used to estimate whether the modeled effective capacity gains from OEP initiatives, shown in the OEP Mountain Chart, were achieved. An explanation of how these metrics relate to OEP performance is described above in Section 2.1. The average minutes late per flight is based on the scheduled flight time and provides an indication of the extent of capacity constraints in the system, whereas the average number of daily flights represents the demand on the system. These results will be measured at both the NAS-wide level and on an airport basis to attempt to determine cause and affect relationships.

4.2 Additional Macro Level OEP Metrics

As mentioned in Section 1, a number of metrics will be collected and used by the FAA's Air Traffic Organization (ATO) to evaluate overall NAS performance. These metrics are included as macro level measures that will be evaluated under this OEP Metrics Plan. The ATO metrics to be included in the OEP analysis are:

Percent of flights on time

Average minutes of delay for all flights

Ground stop minutes

Ground delay program minutes

Average daily arrival capacity

Average daily flights

Airport efficiency rate

The ATO Airport Efficiency Rate metric is calculated as the total number of airport arrivals divided by the minimum of either the Airport Acceptance Rate (AAR) or the arrival demand. OEP will calculate this metric for the 34 benchmark airports contained in the ASPM dataset. When available, arrival demand used in this metric is based on the estimated time of arrival (ETA) specified in the ETMS departure (DZ) message. As the demand is based on an ETA, estimated minutes, if not, hours in advance of actual arrival at the airport, it can be categorized as a performance measure of terminal departure, en route airspace, and terminal and airport arrival. The many phases of flight included in this metric signifies that the resource constraint(s) causing this rate to show a value less than one (i.e., 100% efficiency) can be due to many limitations in multiple domains. Therefore, it is not necessarily possible to associate low scores with problems specifically at the given airport, and correspondingly is not included with the OEP airport metrics. However, it is useful in detecting and illustrating problems for flights destined for the airport.

The OEP will investigate additional NAS level measures to gain a broader understanding of the state of the NAS, as well as to determine the overall performance. These are discussed below.

Average Airborne Delay will be measured for the representative metro-pairs. The average airborne delay will be measured as the difference between actual airborne time (runway departure to runway arrival) minus the airborne time contained in the flight plan. This value for a particular flight can either be positive or negative, with a positive value indicating that a delay occurred and a negative value indicating that the flight was early. Although ASPM only uses the positive values to determine the average delay, the OEP Metrics Plan will evaluate this metric both ways – counting both positive and negative values and only positive values. As the flight plan includes some amount of expected delay, the ***Average Airborne Time*** will also be compared to the ***Minimum Airborne Time***, which will be chosen based on the results of the probability distribution. This will indicate whether scheduled and actual times are increasing or decreasing due to user adjustments for known en route capacity changes. In order to develop macro and meso level statistics, the weight assigned to each representative metro-pair will be by the total number of flights and the total distance flown between the airport pairs. The distance between airport pairs will be based on the shortest possible distance, i.e. the Great Circle Distance (GCD). The average difference may indicate that the OEP en route initiatives are providing more efficient and predictable routes, while a measurement of the variance in the difference will indicate a level of predictability in the en route system. As the method used to calculate this metric is based on airborne time, it represents en route delay as well as terminal departure and arrival delay and airport delay taken in the airborne phase of flight.

Average Block Delay, Average Block Time, and Minimum Block Time will be calculated using the same methods used to calculate airborne metrics. Block time is defined as the gate-to-gate time. This metric will be calculated as the difference between scheduled and actual block times. This metric covers all phases of flight, including taxi-in and taxi-out.

Macro level measures will also include the average of the ***Visual Meteorological Conditions (VMC) Capacity/VMC Throughput Ratio*** and ***Instrument Meteorological Conditions (IMC) Capacity/IMC Throughput ratio*** for the benchmark airports. The definition and methodology for deriving both capacity and throughput are described in Section 5. This metric will be used to measure the stress on the system and provide an indication of whether all runway resources are being fully utilized. At times, the capacity of a terminal facility may be intentionally adjusted due to congestion in the overhead stream in the en route environment.

Departure delays will be measured as the difference between actual and scheduled departure times. Departure delays can be caused by problems throughout the NAS. They can be caused by a variety of airline delay causes, capacity constraints at the departure airport, terminal airspace, or en route airspace. Air traffic management strategies may have been employed to hold the aircraft at the gate due to congestion somewhere in the route of flight or at the arrival airport. As such, this measure is greatly influenced by weather, traffic demand levels, and strategies for responding to demand/capacity imbalances. As departure delays can be caused by a capacity problem in any NAS domain, it is included as a macro level OEP metric. Data sources will be examined to see if it is possible to categorize these delays by cause. The correlation of departure delays by cause is necessary if this metric is to provide meaningful performance information.

Revenue Passenger Miles (RPM), and ***Available Seat Miles (ASM)*** provide an indication of demand and capacity on the system overall. The Bureau of Transportation Statistics data will be used to evaluate these measures on a NAS-wide basis.

System delay measures will provide another indication of system performance at a macro level. The OPSNET database will be used to evaluate the ***Total Number of System Delays*** by category (arrival, departure, en route, Traffic Management System) and by cause (weather, terminal volume, center volume, equipment, runway, and other). In addition, the average delay duration will be computed as the total delay minutes divided by the number of flights affected. As the OPSNET database only includes delays greater than 15 minutes, these metrics are also restricted to delays greater than 15 minutes. As the OPSNET database is primarily populated manually, this plan includes it as a better source of macro and perhaps meso-level measures than of micro-level performance.

The ***Percent of Flights On Time*** is estimated as the percentage of flights that arrive and depart within 15 minutes of scheduled time. This measure will be evaluated at the macro level and possibly the micro and meso levels. It provides an indication of overall system efficiency.

Section 5: OEP Airport Metrics

5.1 Overview of OEP Airport Initiatives

The OEP presents two basic strategies to increase airport and terminal capacity and throughput. The first strategy is to increase available capacity by opening new runways and modifying procedures to allow new operations on existing runways. The second strategy is to take better advantage of available runway capacity by improving airspace design, procedures and standards for arrivals and departures, pilot and controller workload, use of terminal separation standards farther from the airport, and information exchange and decision support for surface operations. These strategies must deal with multiple phases of flight transitioning to and from airports. Improvements in one area (e.g., a new runway) cannot be fully leveraged or realized without associated enhancements (e.g., airspace reconfiguration).

Given projected growth in demand over the next ten years, enhancements in the AD quadrant could contribute nearly two thirds of anticipated OEP-based improvements in throughput when combined with allocated airspace and procedure changes. The implementation of new runways is a large contributor to the benefits of the airport quadrants. New runways will increase both VMC and IMC capacity. The OEP goal for AW is to increase IMC capacity closer to the capacity afforded by VMC.

Weather-related reductions in throughput for airports are primarily due to thunderstorm activity, precipitation, wind or visibility problems that limit the use of runways or require increased spacing between arriving or departing flights. As weather degrades, the spacing applied between aircraft grows, lowering the arrival and departure rates. Large losses in throughput also occur when bad weather requires changes in runway configuration; time is lost due to the change in configuration and the alternative configuration may change the throughput rate.

The strategy for addressing weather-related reductions in throughput is to make airport operations less sensitive to weather. This requires more options for runway configurations, improved timing of operational changes to reduce down time, and more consistent spacing of operations as weather degrades. The near-term focus is reducing the impact of changes in runway configurations. Surveillance improvements and procedures to better coordinate operational changes will allow airports to keep closely spaced parallel runways active under a greater variety of weather conditions. In addition, better weather information may enable the avoidance of premature actions, late reactions that may result in closures, elongated closures, and premature ending of closures that cause downstream delays. In the mid-term, the focus is extending the conditions under which an airport can continue visual operations through cockpit tools and enhanced navigation. In the long-term, improved surface coordination will handle the higher volume. Some airports will add more runways and more instrumented runways to improve the alternative configuration options.

5.2 Description of OEP Airport Metrics

Airport metrics are focused on measuring the OEP AD and AW initiatives using measures of capacity, throughput, and efficiency. Capacity measures will focus on changes in an airport's "called" rate, which represents the expected capacity under varying conditions. Throughput will focus on the number of aircraft actually landing and departing during peak periods.

Capacity at an airport is based on many factors, such as configuration and length of runways, and aircraft mix. Each airport has a theoretical maximum capacity for each runway configuration and therefore for the airport as a whole. Capacity increases can result from improvements such as new runways, landing aids, and changed procedures. Capacity is represented by the number of aircraft that the airport will accept or is expected to depart during a given time period. These rates are established by the facility and are called the airport acceptance rate (AAR) and airport departure rate (ADR). They are also commonly referred to as the "called" rates. Although timely documentation of the AAR and ADR is sometimes lacking, initial analysis will rely on the documented values and determine whether the recorded data is accurate enough to use for the OEP analysis. In addition, other factors, such as equipment outages, may influence the called rates. It will be assumed that these instances are uncommon and will not greatly influence the analysis of a year of data. When increased capacity is provided, the user may either use this capacity to increase the schedule of arrivals and/or departures to meet the new capacity level or to reduce delays in the presence of existing excess demand. When comparing historical airport data, it is important to normalize for airport configuration.

Actual use of airport capacity is measured using a throughput metric. Measuring the actual rate of delivery of aircraft to and from the airport will be used to measure airport throughput. If an airport does not raise their AAR or ADR, it may still increase the airport throughput over a given period of time.

The implementation of new runways does not always lead to an increase in capacity due to terminal and en route constraints or design characteristics. OEP analysis will also investigate the capacity and throughput of the terminal environment to include Terminal Radar Approach Control (TRACON) and transition airspace. By collecting airport demand data and called rates analyses can be conducted to determine if the demand was present but the called rate was not met. This situation may be a result of terminal airspace constraints. This effect is most likely to be seen in areas where multiple airports are in close proximity to one another, such as in the New York metropolitan area, and share terminal and en route transition airspace. Analysis of airports at the meso level will be conducted to identify these constraints and improvements made in reducing them.

The metrics presented for use in measuring the operational impact of the OEP airport initiatives will be analyzed in the context of various levels of demand as well as under varying weather conditions. The focus of capacity and throughput measures at the airport will be during periods of peak demand. Peak demand is used to identify those periods when demand exceeds capacity. At some airports, demand rarely exceeds capacity. The evaluation of peak demand will identify whether this is the case at any of the congested airport included in the OEP metrics evaluation. As with all measures in this plan, the data included in estimation of the metric will be evaluated for abnormal events. Specific data points that represent abnormal events may be discarded. The method used to identify abnormalities may vary by metric. Metrics expected to be included in the initial analysis are presented in italics and bold black print. Those measures that will be added in the future are presented in italics and bold gray print.

5.3 Primary OEP Airport Metrics – Airport VMC and IMC Capacity and Throughput

Initially, the ASPM data will be used to measure 34 of the benchmark airports. These metrics can be used at various levels of measurement (macro, meso, and micro) to reveal overall system performance or that of any individual airport or group of airports. Calculation of all Airport Capacity and Throughput metrics will be based on data for 15 hours a day from 7:00 AM to 10:00 PM local time. If initial findings suggest that this should be expanded to 24 hours per day, then the plan will be modified to incorporate the additional hours. The metrics will be evaluated on an airport basis, as VMC and IMC conditions and the meteorological conditions under which they are defined vary by airport. The metrics call for the use of measuring capacity and throughput as the highest or peak rate over 2 consecutive 15-minute increments. As the data is summarized in 15-minute increments, binning errors can develop. For example, an arrival rush can begin during the last 5 minutes of a 15-minute increment and end in the middle of the next 15-minute increment, thereby potentially causing the data to under represent the size of the rush. It is hoped that by looking at two consecutive 15-minute periods, the majority of the rush will be captured.

Airport VMC Capacity will be estimated as the maximum AAR plus the maximum Airport Departure Rate (ADR) in VMC conditions at benchmark airports. The maximum will equal the highest rate sustained for 2 consecutive 15-minute increments. The fraction of each day in which the maximum is achieved will also be collected and analyzed. The annual average will be used and based on the number of VMC data samples in the previous 365 days. This method was chosen so that data samples always reflect seasonal variations, especially variations in prevailing winds. The sum of these values will be used to create an ***Airport VMC Capacity Index (AVCI)***, with fiscal year 2000 results set to the base of 100. As the maximum AAR and ADR are not likely to be called during the same time periods, this measure does not represent the capacity of the airport. Instead, it will be used to compare against historical data to see if improvement under VMC conditions have been achieved. Changes in the value at the airport will identify which airports have contributed to the overall improvement in the index. Maximum daily AAR's and ADR's will be segregated by runway configuration where appropriate. Additional metrics will be used to control for variations in ceiling, visibility, and wind speed and direction for all airport measures.

Airport VMC Throughput will be estimated to gain an understanding of actual met demand at the airport. The metric will be the summation of the peak VMC arrival throughput and the peak VMC departure throughput at the airport, where the peak is based on 30-minute periods. As with airport VMC capacity measure, the annual average will be used and based on the number of VMC data samples in the previous 365 days. An airport may increase the actual arrival and/or departure rate over previous years without increasing their AAR or ADR. This will provide an indication of the pressure being placed on existing capacity. For this reason, the actual peak demand served and the fraction of the each day when demand remains at that level will also be measured to help understand these situations and future OEP needs. The sum of these values will be used to create an ***Airport VMC Throughput Index (AVTI)***, with fiscal year 2000 results set to the base of 100. As peak arrival and departure throughput rates are not likely to be called during the same time periods, this measure does not represent total airport throughput. Instead, it will be used to compare against historical data to see if improvement under VMC conditions have been achieved. Changes in the value at the airport will identify which airports have contributed to the overall improvement in the index.

Airport IMC Capacity will be estimated as the average of all IMC AAR plus the average of all IMC ADR at benchmark airports. The data will be analyzed in 15-minute increments, and the fraction of each day in which the airport in under IMC conditions will also be collected and analyzed. The annual average will be used and based on the number of IMC data samples in the previous 365 days. This method was chosen so that data samples always reflect seasonal variations, especially variations in prevailing winds and thunderstorm activity. The sum of these values will be used to create an ***Airport IMC Capacity Index (AICI)***, with fiscal year 2000 results set to the base of 100. Changes in the value at an airport will identify which airports have contributed to the overall improvement in the index. Additional metrics will be used to control for variations in runway configurations, ceiling, visibility, and wind speed and direction for all airport measures.

Airport IMC Throughput will be estimated using the average IMC throughput achieved each day. As with the airport IMC capacity measure, the annual average will be used and based on the number of IMC data samples in the previous 365 days. An airport may increase the actual IMC arrival and/or departure rate over previous years without increasing their AAR or ADR. The sum of these values will be used to create an ***Airport IMC Throughput Index (AITI)***, with fiscal year 2000 results set to the base of 100. Changes in the value at the airport level will identify which airports have contributed to the overall improvement in the index.

5.4 Additional Airport Performance Metrics

The ***Fraction of the Day at Peak Capacity and Throughput*** will be computed as the sum of the number of 15-minute increments during the daily 15 hours of traffic divided by the 60-quarter hour increments in each day. For capacity, this measure will be based on the number of respective time increments the maximum AAR and ADR were called, and will provide an indication of the percent of time that airport conditions enable the maximum capacity configuration to be in use. For throughput, this metric will be based on the number of time increments that throughput equaled the called rates and will suggest whether there is additional effective VMC capacity remaining that can be used to service new demand or more effectively handle existing demand through schedule changes.

The existing ***Airport Departure Utilization*** rate, used as an ASPM measurement, will be monitored under the OEP Metrics Plan to provide an indication of whether additional departure capacity exists given current runway configurations. This metric is computed by dividing the total number of actual departures by the minimum of the ADR or departure demand. It will be used to initially evaluate the 34 ASPM Benchmark airports. Values equal to one provide an indication of fully utilized departure capacity. Values less than suggest that higher throughput might be achieved to either serve additional demand or reduce delays in the presence of existing excess demand.

To put both the AD and AW capacity and throughput measures in context a variety of measures will be evaluated. The ***ceiling, visibility, and runway configuration*** will be tracked to determine such things as the frequency distribution, and weather and wind variations and their impacts on capacity. The ***number of hours of VMC per year*** will facilitate comparison of one year's results to another. As the OEP AD and AW initiatives are implemented, the FAA strives to raise the IMC capacity closer to that of VMC capacity. The ***Ratio of VMC Capacity to IMC capacity*** will be calculated to measure the success achieved in reaching this objective.

Time and Distance Flown in Terminal Airspace will be evaluated for arriving and departing aircraft from the given airport. The flight track data, described in Section 6.2 of this document, will allow for partitioning the portion of the flight that pertains to terminal airspace. The average time and distance a flight travels in terminal airspace will provide an efficiency measure in which improvements will be seen through a decrease or no increase in travel time and distance. Computing the standard deviation of these times and distances will provide for a measure of system predictability. A reduction in the variance from the baseline value would indicate a more predictable system that would allow the airspace user to alter their business practices (e.g., scheduling of connections). [The metrics activities will help to determine whether the ETMS data provides enough information to draw any conclusion regarding distance flown in terminal airspace. It may be concluded that Automated Radar Terminal System (ARTS) data is needed to gather enough information to draw any conclusion regarding distance. The analysis of Automated Radar Terminal System ARTS data is labor intensive and will only be pursued if resources permit.]

The OEP Metrics plan will use ***Taxi Times*** as a measure of efficiency and capacity on the airport surface. Taxi time is equal to the time it takes for an aircraft to get between the gate and the runway. It is influenced by several factors including fleet mix, airport characteristics (runways and taxiways in use, proximity of gate to runway), and demand characteristics (departure push versus arrival push). ASPM includes the airline furnished Out-Off-On-In (OOOI) times and calculates an unimpeded taxi time. The average taxi time provides a measure of efficiency of the airport's surface movement and departure capacity, whereas the standard deviation of the taxi times provides a measure of predictability. In past studies, the variability in taxi-out times is much higher than that of taxi-in times. With the implementation of the OEP airport initiatives, the FAA strives to reduce the average and the variability in taxi times for a constant demand level or to keep taxi times the same or better in the face of increased demand. However, safety priorities may cause an increase in taxi-times to prevent runway incursions. When OEP metric results show an increase in taxi time, efforts will be made to determine if the increase was the result of changes put in place to prevent runway incursions. Aircraft movement within the ramp area varies by airport. The FAA controls some ramps and others are controlled by the airlines. The analysis of taxi times will take into account whether the FAA or airlines control the ramps. As with many of the metrics contained in this plan, taxi delays can be caused by capacity constraints throughout the NAS. The initial analysis will also investigate whether useful causal data on taxi delays exists.

Delays taken at the gate can occur for a variety of reasons, some of which pertain to capacity and efficiency and some of which do not. The ***Quantity, Percentage, and Duration of Gate Delays*** will be evaluated, as will the ***On-Time Performance***. However, the cause behind these delays will be important to discern, if meaningful conclusions are to be drawn.

Changes in fuel burn during various phases of flight are an important measure of efficiency. However, the FAA does not have access to actual fuel burn data. In addition, the airlines make conscious business decisions regarding the trade off between fuel consumption and time. This metrics plan calls for the development of a ***Fuel Burn Index*** to capture changes in fuel burn efficiency at the macro level. Initial efforts will focus on developing the appropriate methodology to generate this index.

Section 6: OEP En Route Metrics

6.1 Overview of En Route OEP Initiatives

The OEP goal is to ensure that as airport demand and capacity grow, the increased demands placed on the en route system are met with no increase in en route delay. In addition, the OEP strives to increase efficiency such that more aircraft can fly on their desired route at the desired time and altitude.

In the en route environment, capacity is governed by sectors, separation standards and controller workload. The controller uses procedures, routes, equipment, and automation tools to assure the safe and efficient flow of aircraft. En route capacity can be balanced to demand in short cycles (e.g. adding controllers to sectors, combining or splitting sectors) and long cycles (e.g. establishing new sectors or routes). When demand exceeds capacity in en route airspace, traffic flow limitations may quickly and significantly ripple into other airspace creating delay for many flights.

Almost half of the delays and cancellations experienced in the NAS arise from disruptions directly related to the weather, reaction to that weather, or the congestion it creates. Severe weather in en route airspace can block access to key sectors and shift traffic flows to create new congestion points. Imprecise weather predictions can create difficulty in identifying airspace and aircraft that will be impacted by weather or the resulting congestion is magnified by the uncertainty in the location, movement, and severity of the weather conditions. Extra capacity must be set aside for contingencies and potential congestion arising from shifts in typical flows.

Delays taken in the en route environment are not necessarily due to congestion or capacity shortfalls en route. Conversely, delays due to en route congestion may be taken at the airport or in the terminal environment. Aircraft may be held in the en route environment waiting for limited terminal or airport resources to become available. For example, in situations where demand exceeds capacity for short periods of time at an airport, the en route system is expected to absorb some amount of the airport delay without creating serious problems at the given airport or at other airports. However, due to growth in overall air traffic, the en route system has reached a level of near saturation during busy weekday hours in several key areas of the country.

To mitigate the possibility of the en route system reaching complete gridlock, the OEP has focused several initiatives on gaining en route capacity and efficiency. The core strategy for minimizing en route congestion is increased flexibility to prevent gridlock from forming, by increases in physical capacity, decreases in controller workload, and better matching capacity and demand. The OEP strategy for addressing weather-related congestion is to reduce the uncertainty, and tailor reactions to a finer-grain response, requiring real-time data sharing of forecasts, expected reactions, traffic flow shifts, and operational decision-making.

6.2 Description of En Route Metrics

The operational impact of the OEP en route initiatives will focus on accessibility (capacity and throughput) and efficiency (flight time and distance). As delays and excess time and distance experienced in the en route domain can be due to capacity constraints in all NAS domains, it will be difficult to isolate and measure the performance of the en route system alone. The effects of airport capacity, user demand, weather, and geography cause this effort to be complicated.

Another major challenge is to segment the en route metrics into periods of good and bad weather. Convective weather is different from IMC conditions at airports, and is more difficult to determine, as the data is not as readily available. A variety of methods will be explored, including comparison of results during seasons of less convective en route weather to seasons with a great deal of en route convective weather. An alternative approach will analyze lightening strike data to identify days with little or no convective weather.

Two different major data sources will initially be analyzed in support of the en route metrics effort. The ASPM data will be used to evaluate more system-wide measures, with the hope that simultaneous analysis of multiple metrics will enable conclusions to be drawn about en route system capacity and efficiency improvements. A second data source that will be used is being created from archived ETMS data and is described in detail in the next subsection of this document. As this data source is being created for this effort, initial analysis results may not include any metrics created from it. As more detailed data sources become available and are analyzed, the findings may lead to the creation of improved primary and secondary en route performance metrics.

En route metrics will initially be analyzed through the evaluation of fifty-two (52) major metropolitan pairs, as detailed in Section 3 of this document, and on major areas of en route congestion. The metro-pairs will be used to evaluate changes in delay, as well as, changes in flight time and distance. Operational improvements in en route throughput will be measured by counting flights crossing a theoretical line or gate through known congested en route areas. The initial evaluation will be used to help determine which metrics best measure en route capacity and efficiency, and whether an expanded evaluation to more metropolitan pairs is warranted.

Future analysis of en route metrics will investigate the use of peak en route sector and center throughput as a measure of en route capacity. However, it is not adequate to analyze the operational impact of the OEP initiatives on an en route sector or center basis alone. While each sector has a Monitor Alert Parameter that is used to ensure safe operations, the center can adjust sector structures and tactically combine or split sectors to manage congestion. Therefore, any analysis of throughput using sector and center counts must be based on groups of sectors in strategic geographical areas to yield any meaningful conclusions. For this reason, this method will likely not be pursued for the initial evaluation period.

Metrics expected to be included in the initial analysis are presented in italics and bold black print. Those measures that will be added in the future are presented in italics and bold gray print.

6.2 Methodologies Using ETMS Data

In addition to city-pairs and metro-pairs, flight path corridors will be analyzed to capture aircraft throughput in congested en route areas. For example, air traffic traversing the Great Lakes Corridor is a known congested en route flight path. Figure 4 illustrates how a gate can be drawn to capture flights that traverse this corridor. The number of aircraft traversing through the gate over a given time period will be used to represent the throughput for that gate. The flights can then be analyzed and their flight time and distance measured.

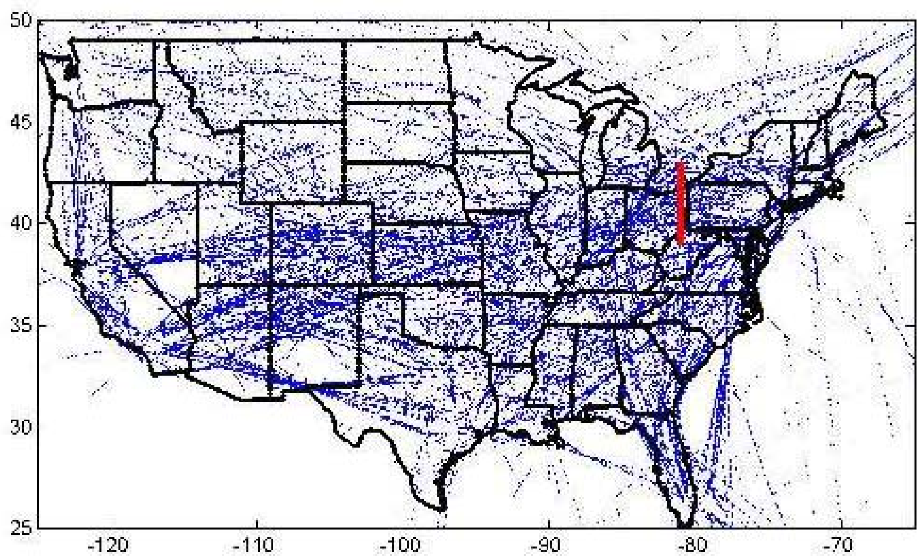

Figure 4. NAS-Wide Air Traffic Pattern – Great Lakes Corridor Analysis

Flight track data will be parsed to obtain the detailed data needed to quantify efficiency metrics. Figure 5 illustrates how flight tracks can be partitioned for the purpose of gathering data for each flight segment. The lines drawn across the flight path are perpendicular to the great circle route (GCR) between the flight's origin and destination. Although it is known that the severity and direction of winds has the greatest influence on the desired flight path, the great circle distance is used as a constant reference point that represents the optimal route in the absence of winds. These perpendicular lines begin at the origin airport and would extend the entire flight path into the destination airport. En route airspace is partitioned from terminal airspace at 40 nautical miles (NM). Although the actual separation point between terminal and en route airspace varies by location, the 40 NM line is seen as a constant reference point against which different time periods can be compared. Additional lines are drawn from the origin airport every 100 NM until 40 NM from the destination airport, as well as a line at the midpoint of the great circle route.

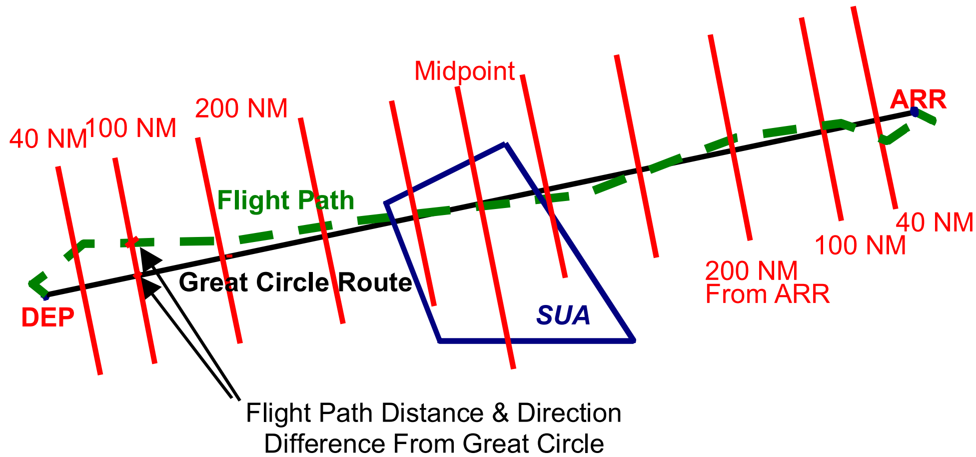

Figure 5. Flight Efficiency Measurement Methodology

The following list shows the data that will be captured with each line crossing:

- Flight ID
- Line crossing date and time
- Line crossing latitude and longitude
- Distance flown (to and from various lines)
- Line crossing altitude
- Distance and direction of actual crossing from the shortest distance great circle arc (direction as plus or minus to store in single numerical field)
- Confidence factor (distance between nearest data points each side of a line from which crossing point is interpolated and distance to nearest point)

Flight time and distance is captured as the flight path crosses each of the lines. The actual flight times and distances can then be compared to a baseline or the great circle distance to capture a measure of efficiency. This methodology may also lend itself to the analysis of user access to Special Use Airspace (SUA).

6.3 Primary OEP En Route Metrics – Average En Route Delay, Peak Throughput

The data needed to develop the primary en route metrics will take time to develop. Therefore, initial analysis results may not include the measurement of the primary en route metrics. However, some of the Macro Level Metrics, detailed in Section 4, contain an en route component, which may provide an indication of en route performance.

Average En Route Delay will be measured for the representative metro-pairs. This metric is dependent on the parsed ETMS data. The flight segments (shown in Figure 5) chosen to represent En Route delay will be determined from the data analysis, and may vary by metro-pair. This metric is titled en route delay, but it will likely represent more than en route delay. The time and distances captured may not represent delay, per se, but system inefficiencies. In addition, delay experienced in the en route environment, but may not be caused by en route capacity constraints. In addition to the average, the distribution of results will also be examined, as discussed in Section 3.6.

Once the parsed ETMS database has been established, measurement of traffic through the "gates," described earlier in this document, will enable the generation of a ***Peak En Route Throughput*** measure. This will be calculated based on the peak traffic counts for each of the gates. The results from each "gate" will be used to create a ***Peak En Route Throughput Index (PERTI)***, which will be normalized to 100 at the base period of fiscal year 2000.

6.4 Additional En Route Performance Metrics

A variety of metrics will be used to aid in the evaluation of the capacity and efficiency metrics detailed in this section. These measures will help to validate and understand analysis findings, calculate metric results, and to put the metrics in context.

The ***Total Number of Flights*** used will vary by metric calculation methodology and will include the total number of flights for all ASPM airports, all metro-pair airports, and all flights flying with a filed flight plan.

The ***GCD*** between the metro-pair will be based on the calculated great distance between origin and destination airport.

Through traffic management initiatives, delays due to en route capacity shortfalls are often taken via departure delays. The ***Average Departure Delay*** will be evaluated to capture this capacity shortfall. The average will be estimated for each of the metro-pairs and the average for all metro-pairs will be calculated at the macro level by weightings of both total number of flights and total distance. As discussed previously, it will be important to segregate this metric by cause.

There are a number of measures that are broadly based and capture more than en route operational performance. However, they are included as en route metrics because they all contain an en route component. These metrics include:

Average Airborne Delay, and Minimum and Average Airborne Time (Scheduled and Actual)

Average Block Delay, and Minimum and Average Block Time (Scheduled and Actual)

As all of these metrics have already been described under the Macro Level OEP Metrics, they are detailed above in Section 4 of this document.

Measures of average speed and distance flown between metro-pairs can provide an indication of en route system efficiency and capacity. Initially, the metric used to measure the speed metric will be calculated based on the minimal distance between airport pairs (GCD) divided by the average time en route. This measure has been used in previous analyzes and is referred to as ***"Speed Made Good."*** Metrics work to date has found a strong correlation between total flight distance and "speed made good." Therefore, this metric may only provide a meaningful comparison on a route-to-route basis, and may not be a useful macro level indicator. Additional research will be conducted to determine if a data source exists that will enable a true ***Average Speed En Route*** metric to be added to this analysis. This metric will be calculated using both Average Airborne Delay and Average En Route Delay.

An aircraft is diverted from its' intended arrival airport when there is an emergency on-board or when the aircraft has insufficient fuel to continue airborne holding to wait for an available arrival slot. The OEP Metric Plan is interested in measuring the latter form of diversions. Initially, the total ***Number of Diversions*** will be evaluated. However for this metric to be truly meaningful, the ***Number of Diversions by Cause*** will be needed. In addition, it will be important to correlate these diversions to a capacity constraint in the system for this measure to have meaning. The breakout of diversions by cause will be labor intensive and, therefore, may not be included in the initial OEP metrics results.

There are many reasons why flights are cancelled. Some of these include unavailability of aircraft due to mechanical problems, unavailability of crew due to upstream system delays, and airline attempts to reduce demand in the face of severe capacity constraints in the NAS, most often caused by weather. Therefore, an increase in the rate of cancellations is not necessarily bad. It must be measured in the context of other variables and must be segmented by cause. The ***Number or Rate of Cancellations*** may be a useful measure when evaluated in context. A proper analysis of the ***Number of Cancellations by Cause*** may be too labor intensive to warrant measurement at this time.

Revenue Passenger Miles (RPM), and ***Available Seat Miles (ASM)*** also provide an indication of demand and capacity of a given route. RPM and ASM will be used to evaluate these measures on a metro-pair basis. The calculation of the ***Average ASM per Flight*** will help to provide an indication of changes in fleet mix and may identify areas where additional passenger capacity can be realized through the use of larger planes.

Peak Sector or Center Throughput will measure the actual rate (throughput measured by entry and exit) of traffic traversing en route airspace during periods of peak demand. This metric can be measured at the center level or at the individual sector level and used as an indicator of improved user access. The number of aircraft in a sector can be calculated through identification of aircraft that 1) track control is assigned to the sector, 2) voice communications is assigned to the sector, or 3) the aircraft is within the physical boundaries of the sector. The first option uses the handoff of track control to determine when an aircraft is in a sector. This can be measured using Host Aircraft Management Executive (HAME) data. Obtaining the actual boundary crossing time of the flight into a sector requires ETMS, Host, and ARTS track data. The third option utilizes the time of transfer of voice communications. However, measurement of voice communication transfers requires voice tape analysis. All of these measures are labor intensive, and therefore, inclusion will be dependent on the level of resources put in place to execute this plan. Tools in development by the FAA's Office of Air Traffic Airspace Management (ATA) lab may facilitate the measurement of sector and center throughput. To date, the track control method is the most automated way of calculating the time an aircraft is in a sector.

Rate of Access to Special Use Airspace focuses on the actual usage of Special Use Airspace (SUA) by civilian traffic when it is not in use by the military. Although some indication of SUA use may result from the flight segment analysis, further research needs to take place to determine the data available or needed to properly evaluate this performance measure. Initial efforts will focus on identifying relevant data.

Appendix A: OEP En Route Analysis: Recommended Metro-pairs

Metropolitan Pair	Airport Pairs
Seattle and San Francisco Bay	SEA-SFO
	SEA-OAK
	SEA-SJC
	SFO-SEA
	OAK-SEA
	SJC-SEA
San Francisco Bay and Los Angeles	SFO-LAX
	SFO-ONT
	OAK-LAX
	OAK-ONT
	SJC-LAX
	SJC-ONT
	LAX-SFO
	LAX-SJC
	LAX-OAK
	ONT-SFO
	ONT-SJC
	ONT-OAK
	BUR-SFO
	LGB-SFO
	SNA-SFO
	BUR-OAK
	LGB-OAK
	SNA-OAK
	BUR-SJC
	LGB-SJC
	SNA-SJC
	SFO-BUR
	SFO-LGB
	SFO-SNA
	OAK-BUR
	OAK-LGB
	OAK-SNA
	SJC-BUR
	SJC-LGB
	SJC-SNA
Los Angeles and Las Vegas	LAX-LAS
	ONT-LAS
	LAS-LAX
	LAS-ONT
	BUR-LAS
	LGB-LAS
	SNA-LAS
	LAS-BUR
	LAS-LGB
	LAS-SNA

Metropolitan Pair	Airport Pairs
Chicago and San Francisco Bay	SFO-ORD
	SFO-MDW
	OAK-ORD
	OAK-MDW
	SJC-ORD
	SJC-MDW
	ORD-SFO
	ORD-OAK
	ORD-SJC
	MDW-SFO
	MDW-SJC
	MDW-OAK
Chicago and Los Angeles	LAX-ORD
	LAX-MDW
	ONT-ORD
	ONT-MDW
	ORD-LAX
	ORD-ONT
	MDW-LAX
	MDW-ONT
	ORD-BUR
	ORD-LGB
	ORD-SNA
	MDW-BUR
	MDW-LGB
	MDW-SNA
	BUR-ORD
	LGB-ORD
	SNA-ORD
	BUR-MDW
	LGB-MDW
	SNA-MDW
Dallas/Fort Worth and Houston	DFW-IAH
	DFW-HOU
	IAH-DFW
	HOU-DFW
	DAL-IAH
	DAL-HOU
	IAH-DAL
	HOU-DAL
Dallas/Fort Worth and Chicago	DFW-ORD
	DFW-MDW
	ORD-DFW
	MDW-DFW
	DAL-ORD
	DAL-MDW
	ORD-DAL
	MDW-DAL

Metropolitan Pair	Airport Pairs
Dallas/Fort Worth and Atlanta	DFW-ATL
	ATL-DFW
	DAL-ATL
	ATL-DAL
Chicago and Minneapolis	ORD-MSP
	MDW-MSP
	MSP-ORD
	MSP-MDW
Chicago and Atlanta	ORD-ATL
	MDW-ATL
	ATL-ORD
	ATL-MDW
Chicago and New York	ORD-LGA
	ORD-EWR
	ORD-JFK
	MDW-LGA
	MDW-EWR
	MDW-JFK
	LGA-ORD
	LGA-MDW
	EWR-ORD
	EWR-MDW
	JFK-ORD
	JFK-MDW
	TEB-ORD
	HPN-ORD
	TEB-MDW
	HPN-MDW
	ORD-TEB
	MDW-TEB
	ORD-HPN
	MDW-HPN
Chicago and Washington, D.C.	ORD-BWI
	ORD-DCA
	ORD-IAD
	MDW-BWI
	MDW-DCA
	MDW-IAD
	BWI-ORD
	BWI-MDW
	DCA-ORD
	DCA-MDW
	IAD-ORD
	IAD-MDW

Metropolitan Pair	**Airport Pairs**		**Metropolitan Pair**	**Airport Pairs**		**Metropolitan Pair**	**Airport Pairs**
Las Vegas and Phoenix	LAS-PHX		Boston and Washington, D.C.	BOS-BWI			
	PHX-LAS			BOS-DCA			
				BOS-IAD			
Denver and Chicago	DEN-ORD			BWI-BOS			
	DEN-MDW			DCA-BOS			
	ORD-DEN			IAD-BOS			
	MDW-DEN						
New York and Washington, D.C.	LGA-BWI		New York and San Francisco Bay	LGA-SFO		Los Angeles and New York	LAX-LGA
	LGA-DCA			LGA-OAK			LAX-EWR
	LGA-IAD			LGA-SJC			LAX-JFK
	EWR-BWI			EWR-SFO			ONT-LGA
	EWR-DCA			EWR-OAK			ONT-EWR
	EWR-IAD			EWR-SJC			ONT-JFK
	JFK-BWI			JFK-SFO			LGA-LAX
	JFK-DCA			JFK-OAK			LGA-ONT
	JFK-IAD			JFK-SJC			EWR-LAX
	BWI-LGA			SFO-LGA			EWR-ONT
	BWI-EWR			SFO-EWR			JFK-LAX
	BWI-JFK			SFO-JFK			JFK-ONT
	DCA-LGA			OAK-LGA			LAX-HPN
	DCA-EWR			OAK-EWR			LAX-TEB
	DCA-JFK			OAK-JFK			ONT-HPN
	IAD-LGA			SJC-LGA			ONT-TEB
	IAD-EWR			SJC-EWR			HPN-LAX
	IAD-JFK			SJC-JFK			HPN-ONT
	HPN-BWI			SFO-TEB			TEB-LAX
	HPN-DCA			OAK-TEB			TEB-ONT
	HPN-IAD			SJC-TEB			BUR-LGA
	TEB-BWI			SFO-HPN			BUR-EWR
	TEB-DCA			OAK-HPN			BUR-JFK
	TEB-IAD			SJC-HPN			BUR-HPN
	BWI-HPN			TEB-SFO			BUR-TEB
	DCA-HPN			TEB-OAK			LGB-LGA
	IAD-HPN			TEB-SJC			LGB-EWR
	BWI-TEB			HPN-SFO			LGB-JFK
	DCA-TEB			HPN-OAK			LGB-HPN
	IAD-TEB			HPN-SJC			LGB-TEB
							SNA-LGA
Boston and New York	BOS-LGA		San Francisco Bay and Boston	SFO-BOS			SNA-EWR
	BOS-EWR			OAK-BOS			SNA-JFK
	BOS-JFK			SJC-BOS			SNA-HPN
	LGA-BOS			BOS-SFO			SNA-TEB
	EWR-BOS			BOS-OAK			LGA-BUR
	JFK-BOS			BOS-SJC			EWR-BUR
	HPN-BOS						JFK-BUR
	TEB-BOS		Los Angeles and Boston	LAX-BOS			HPN-BUR
	BOS-HPN			ONT-BOS			TEB-BUR
	BOS-TEB			BOS-LAX			LGA-LGB
				BOS-ONT			EWR-LGB
Denver and Minneapolis	DEN-MSP			BUR-BOS			JFK-LGB
	MSP-DEN			LGB-BOS			HPN-LGB
				SNA-BOS			TEB-LGB
				BOS-BUR			LGA-SNA
				BOS-LGB			EWR-SNA
				BOS-SNA			JFK-SNA
							HPN-SNA
							TEB-SNA

Metropolitan Pair	Airport Pairs
San Francisco Bay and Washington, D.C.	SFO-BWI
	SFO-DCA
	SFO-IAD
	OAK-BWI
	OAK-DCA
	OAK-IAD
	SJC-BWI
	SJC-DCA
	SJC-IAD
	BWI-SFO
	BWI-OAK
	BWI-SJC
	DCA-SFO
	DCA-OAK
	DCA-SJC
	IAD-SFO
	IAD-OAK
	IAD-SJC
Los Angeles and Washington, D.C.	LAX-BWI
	LAX-DCA
	LAX-IAD
	ONT-BWI
	ONT-DCA
	ONT-IAD
	BWI-LAX
	BWI-ONT
	DCA-LAX
	DCA-ONT
	IAD-LAX
	IAD-ONT
	BUR-BWI
	LGB-BWI
	SNA-BWI
	BWI-BUR
	BWI-LGB
	BWI-SNA
	DCA-BUR
	DCA-LGB
	DCA-SNA
	BUR-DCA
	LGB-DCA
	SNA-DCA
	BUR-IAD
	LGB-IAD
	SNA-IAD
	IAD-BUR
	IAD-LGB
	IAD-SNA

Metropolitan Pair	Airport Pairs
New York and Miami	LGA-MIA
	LGA-FLL
	EWR-MIA
	EWR-FLL
	JFK-MIA
	JFK-FLL
	MIA-LGA
	MIA-EWR
	MIA-JFK
	FLL-LGA
	FLL-EWR
	FLL-JFK
	MIA-HPN
	MIA-TEB
	FLL-HPN
	FLL-TEB
	HPN-MIA
	HPN-FLL
	TEB-MIA
	TEB-FLL
Atlanta and New York	LGA-ATL
	EWR-ATL
	JFK-ATL
	ATL-LGA
	ATL-EWR
	ATL-JFK
	ATL-HPN
	ATL-TEB
	HPN-ATL
	TEB-ATL
Atlanta and Washington, D.C.	ATL-BWI
	ATL-DCA
	ATL-IAD
	BWI-ATL
	DCA-ATL
	IAD-ATL
Louisville and Atlanta	SDF-ATL
	ATL-SDF
Philadelphia and Atlanta	PHL-ATL
	ATL-PHL
Atlanta and Miami	ATL-MIA
	ATL-FLL
	MIA-ATL
	FLL-ATL

Metropolitan Pair	Airport Pairs
Los Angeles and Dallas/Fort Worth	LAX-DFW
	ONT-DFW
	DFW-LAX
	DFW-ONT
	LAX-DAL
	ONT-DAL
	BUR-DAL
	LGB-DAL
	SNA-DAL
	DAL-LAX
	DAL-ONT
	DAL-BUR
	DAL-LGB
	DAL-SNA
	BUR-DFW
	LGB-DFW
	SNA-DFW
	DFW-LGB
	DFW-BUR
	DFW-SNA
Portland and Seattle	PDX-SEA
	SEA-PDX
San Francisco Bay &Las Vegas	SFO-LAS
	OAK-LAS
	SJC-LAS
	LAS-SFO
	LAS-OAK
	LAS-SJC
San Diego and San Francisco Bay	SAN-SFO
	SAN-OAK
	SAN-SJC
	SFO-SAN
	OAK-SAN
	SJC-SAN
Chicago and Houston	ORD-IAH
	MDW-IAH
	IAH-ORD
	IAH-MDW
	HOU-ORD
	HOU-MDW
	ORD-HOU
	MDW-HOU

Metropolitan Pair	Airport Pairs
Portland and San Francisco Bay	PDX-SFO
	PDX-OAK
	PDX-SJC
	SFO-PDX
	OAK-PDX
	SJC-PDX
Orlando and Miami	MCO-MIA
	MCO-FLL
	MIA-MCO
	FLL-MCO
Seattle and Los Angeles	SEA-LAX
	SEA-ONT
	LAX-SEA
	ONT-SEA
	SEA-BUR
	SEA-LGB
	SEA-SNA
	BUR-SEA
	LGB-SEA
	SNA-SEA
Orlando and New York	MCO-LGA
	MCO-EWR
	MCO-JFK
	LGA-MCO
	EWR-MCO
	JFK-MCO
	HPN-MCO
	MCO-HPN
	TEB-MCO
	MCO-TEB
Detroit and Chicago	DTW-ORD
	DTW-MDW
	ORD-DTW
	MDW-DTW
San Francisco Bay and Phoenix	SFO-PHX
	OAK-PHX
	SJC-PHX
	PHX-SFO
	PHX-OAK
	PHX-SJC
San Francisco Bay and Denver	SFO-DEN
	OAK-DEN
	SJC-DEN
	DEN-SFO
	DEN-OAK
	DEN-SJC

Metropolitan Pair	Airport Pairs
Dallas/Fort Worth and Denver	DFW-DEN
	DEN-DFW
	DAL-DEN
	DEN-DAL
Philadelphia and Chicago	PHL-ORD
	PHL-MDW
	ORD-PHL
	MDW-PHL
Greater Cincinnati and Chicago	CVG-ORD
	CVG-MDW
	ORD-CVG
	MDW-CVG
Cleveland and Chicago	CLE-ORD
	CLE-MDW
	ORD-CLE
	MDW-CLE
St. Louis & Chicago	STL-ORD
	STL-MDW
	ORD-STL
	ORD-MDW
Louisville and Chicago	SDF-ORD
	SDF-MDW
	ORD-SDF
	MDW-SDF
Louisville and Washington, D.C.	SDF-BWI
	SDF-DCA
	SDF-IAD
	BWI-SDF
	DCA-SDF
	IAD-SDF
Denver & Los Angeles	DEN-LAX
	DEN-ONT
	DEN-BUR
	DEN-LGB
	DEN-SNA
	LAX-DEN
	ONT-DEN
	BUR-DEN
	LGB-DEN
	SNA-DEN

Metropolitan Pair	Airport Pairs
Chicago and Boston	ORD-BOS
	MDW-BOS
	BOS-ORD
	BOS-MDW
Phoenix and Los Angeles	LAX-PHX
	ONT-PHX
	PHX-LAX
	PHX-ONT
	BUR-PHX
	LGB-PHX
	SNA-PHX
	PHX-BUR
	PHX-LGB
	PHX-SNA

Appendix B: POD Metrics Discussion and Example

The OEP metrics activities will be focused primarily on evaluating the performance of all OEP solutions on the entire NAS. The analysis performed by PODs is more locally based. POD metrics link operational improvements to specific OEP technologies/solutions and are focused on measurement during specific time periods in specific locations.

With PODs having the responsibility for successful solution implementation, their metrics efforts have a more near-term focus than the OEP metrics. Both OEP and POD metrics focus on the same basic operational improvements of capacity and efficiency, but POD metrics will focus on specific locations and shorter timeframes — where and when a solution is newly implemented. The PODs desire feedback on solution implementation success almost immediately after new technologies become operational, while OEP measures of annual indices may not identify the effects of new OEP solutions for 6 months or more after implementation. Over longer time periods it is expected that POD measures and OEP measures would show similar results.

One of the major differences between POD and OEP metrics is that POD metrics include ***mechanism*** measures. Mechanisms are the means by which an operational improvement is enabled. Mechanism metrics track the actual use of OEP solutions with operational improvements. Mechanism metrics include data on usage rates of tools, user equipage rates, pilot training, and new procedures. For example, when measuring the benefit of the User Request Evaluation Tool (URET), the Free Flight office collected detailed data on the use of URET functionality and correlated it with flight track data that indicated shorter routes were flown. Without data indicating when and where tools are being used it is difficult to make a link between a tool and operational improvement. Figure B-1 below is an example of a mechanism metric, specifically, the use of the URET tool for entering route amendments. Mechanism measures, such as these, can assist implementation teams in identifying where additional training may be necessary. Figure B-2 is the associated operational change in terms of reduced flying distance (translating to time savings).

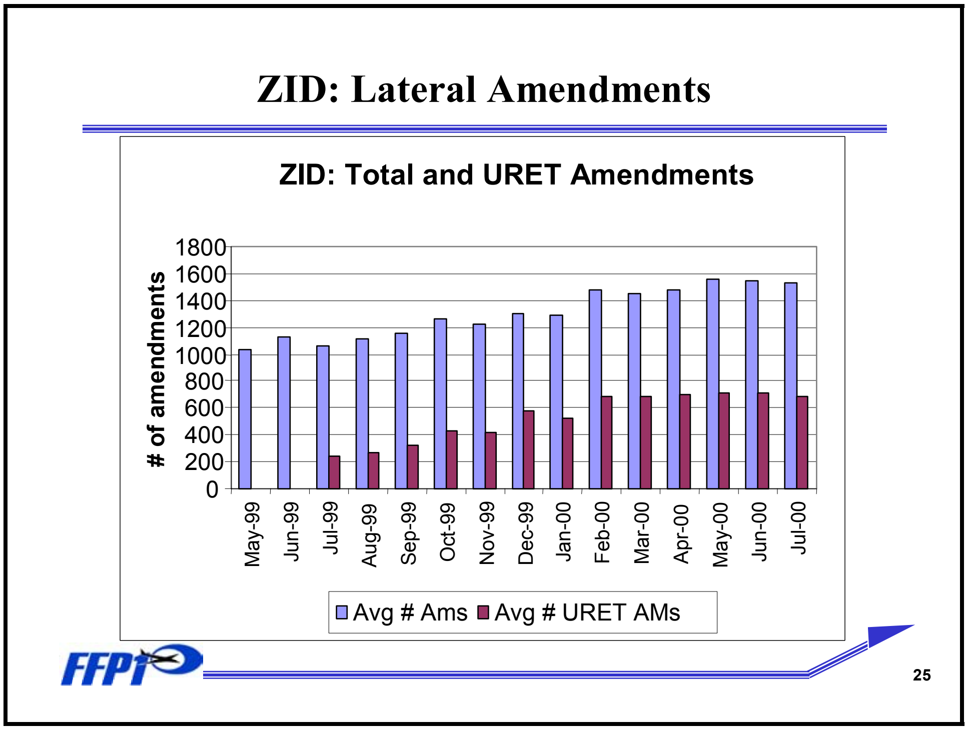

Figure B-1. URET Mechanism Metrics

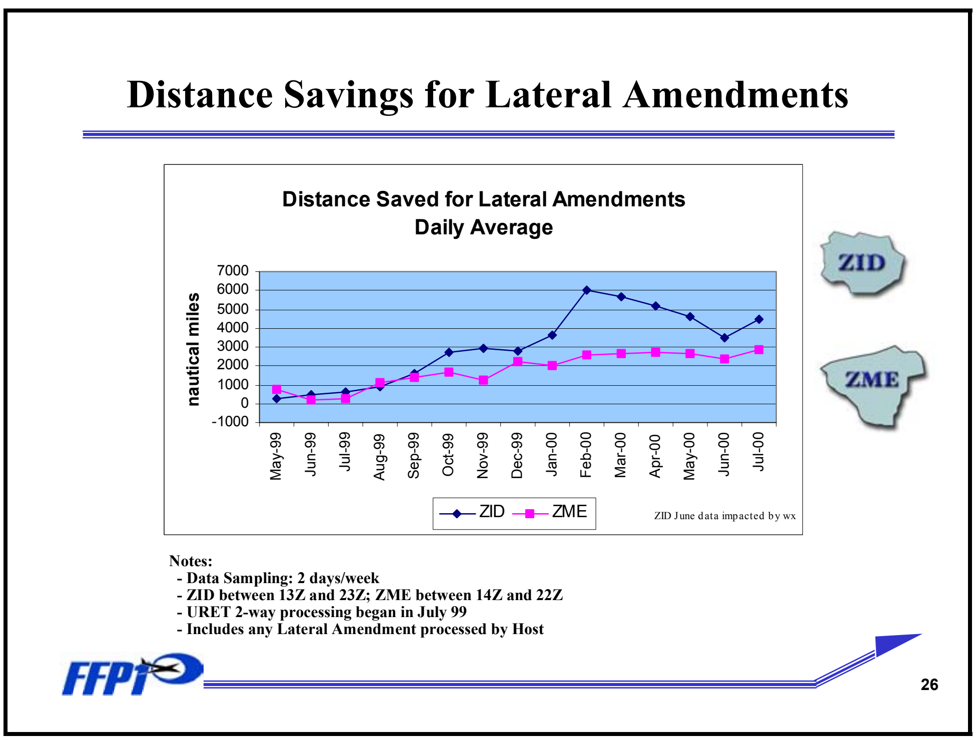

Figure B-2. URET Distance Savings

Since POD measures are often focused on shorter time periods, care must be taken to normalize these measures for other confounding factors such as changes in demand, weather, airport changes etc. For this reason it is recommended that POD's develop a metrics plan establishing data collection requirements one year prior to implementation. A sample metrics plan can be found on the Free Flight Website at http://ffp1.faa.gov/approach/approach_ben_met.asp. Safety assessments and risk analyses should be conducted during the development and implementation phase of solutions, as appropriate. PODs are also responsible for these analyses, which are documented in the OEP Smart Sheets.

The majority of POD metrics are more narrowly focused on a specific improvement at a specific location. This enables them to use more detailed methodology. One type of methodology that can be employed by PODs is the use of post-event surveys of controller, traffic management units (TMUs) and users. With this method, the aviation specialist provides subjective, yet expert judgment, on how operations would have occurred had the tool or new procedure not been in use. For example, a survey of TMUs could yield information such as when restrictions would be put in place, what the restrictions would be, and when the restrictions would be removed with and without the new solution. These capacity values and durations can be used as inputs to a queuing model, which will estimate the delays associated with both scenarios. This method was successfully used in the estimation of Integrated Terminal Weather System (ITWS) benefits. It is a particularly good method to use for evaluation of operational prototypes, such as ITWS.

In summary, mechanism metrics are a key indicator that changes in operational User Benefit metrics are indeed a result of specific OEP initiatives. To clearly attribute operational changes in capacity or efficiency to a particular solution, data indicating a tool or procedure is in place and being used operationally is needed. Of course, measured use of a new controller tool does not guarantee that flight routes or capacity will be improved. On the other hand, if the tool is not being used any observed operational improvement would have to be due to a factor other than the tool. The connection between tool usage and operational change is a key factor in POD analysis of operational benefits.

Appendix C: Acronyms

AAR	Airport Acceptance Rate
ADR	Airport Departure Rate
AICI	Airport IMC Capacity Index
AITI	Airport IMC Throughput Index
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ASM	Available Seat Mile
ASPM	Aviation System Performance Measures
ATA	FAA’s Office of Air Traffic Airspace Management
ATC	Air Traffic Control
ATL	Atlanta Hartsfield Airport
ATO	FAA’s Air Traffic Organization
AD	Arrival/Departure OEP Quadrant
AVCI	Airport VMC Capacity Index
AVTI	Airport VMC Throughput Index
AW	Airport Weather OEP Quadrant
BOS	Boston Logan International Airport
BWI	Baltimore Washington Airport
CLE	Cleveland Airport
CLT	Charlotte/Douglas International Airport
CONUS	Continental United States
CVG	Cincinnati Covington Airport
DCA	Washington Reagan National Airport
DEN	Denver Airport
DFW	Dallas/Fort Worth International Airport
DOT	Department of Transportation
DTW	Detroit Metropolitan Wayne County Airport
DZ	ETMS Departure Message
ER	En Route Congestion Quadrant
ETA	Estimated Time of Arrival
ETMS	Enhanced Traffic Management System
EW	En Route Severe Weather OEP Quadrant
EWR	Newark Airport
FAA	Federal Aviation Administration
FLL	Ft. Lauderdale Airport
FFP1	Free Flight Phase One
FY	fiscal year
GCD	Great Circle Distance
GCR	Great Circle Route
HAME	Host Aircraft Management Executive
HNL	Honolulu Airport
IAD	Washington Dulles International Airport

IAH	Houston Airport
ID	Identification
IMC	Instrument Meteorological Conditions
ITWS	Integrated Terminal Weather System
JFK	New York John F. Kennedy International Airport
LAS	Las Vegas McCarran International Airport
LAX	Los Angeles International Airport
LGA	LaGuardia Airport
MCO	Orlando Airport
MDW	Chicago Midway Airport
MEM	Memphis International Airport
MIA	Miami International Airport
MSP	Minneapolis St. Paul Airport
NAS	National Airspace System
NM	Nautical Mile
OAK	Metropolitan Oakland International Airport
OEP	Operational Evolution Plan
OOOI	Out, Off, On, In
OPSNET	Operations Network
ORD	Chicago O'Hare International Airport
PBO	Performance Based Organization
PDX	Portland Airport
PERTI	Peak En Route Throughput Index
PHL	Philadelphia International Airport
PHX	Phoenix International Airport
PIT	Pittsburgh Airport
POD	Point of Delivery
RPM	Revenue Passenger Mile
SAN	San Diego Airport
SEA	Seattle-Tacoma International Airport
SFO	San Francisco International Airport
SJC	San Jose International Airport
SLC	Salt Lake City Airport
STL	St. Louis Lambert Field
SUA	Special Use Airspace
TMS	Traffic Management System
TMU	Traffic Management Unit
TPA	Tampa Airport
TRACON	Terminal Radar Approach Control
URET	User Request Evaluation Tool
VMC	Visual Meteorological Conditions
ZID	Indianapolis ARTCC
ZME	Memphis ARTCC